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MISCELLANEOUS.

Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.

SOLUTIONS OF PROBLEMS.

16 Yale Senior Prize Problem.---Contributed by H. A. NEWTON, LL. D., Professor of Mathematics, Yale University, New Haven Connecticut.

The axes of two right cylinders whose bases are circles of 4 and 6 inches radius respectively, intersect at right angles. Compute to four decimal places the lengths of the *curves* of intersection of the two surfaces.

Solution by F. P. MATZ, D. Sc, Ph. D., Professor of Mathematics and Astronomy in Irving College, Mechanicsburg, Pennsylvania.

Make $m=6$ inches, and $n=4$ inches; then the Cartesian equations of the cylinders become $z^2+x^2=m^2$ ....(1) and $y^2+x^2=n^2$ ....(2).

$$\therefore \frac{dz}{dx}=-\frac{x}{z}=-\frac{x}{\sqrt{(m^2-x^2)}}\ldots.(3),$$

$$\text{and } \frac{dy}{dx}=-\frac{x}{y}=-\frac{x}{\sqrt{(n^2-x^2)}}\ldots.(4).$$

Hence the expression for the *lengths* of the *curves* of intersection of the two surfaces becomes, *Todhunter's Integral Calculus*, p. 116,

$$L=8\int_0^n\sqrt{\left(1+\frac{x^2}{m^2-x^2}+\frac{x^2}{n^2-x^2}\right)}dx\ldots.(5).$$

Make $c^2=n^2/m^2$, and $x=n\sin\phi$; then $dx=n\cos\phi d\phi$. Transforming (5), etc.,

$$L=8\int_0^n\sqrt{\left(\frac{m^2n^2-x^4}{(m^2-x^2)(n^2-x^2)}\right)}dx=8n\int_0^{\frac{1}{2}\pi}\sqrt{\left(\frac{1-c^2\sin^4\phi}{1-c^2\sin^2\phi}\right)}d\phi$$

$$=8n\int_0^{\frac{1}{2}\pi}[1+\tfrac{1}{2}c^2\sin^2\phi+(\tfrac{3}{8}c^4-\tfrac{1}{2}c^2)\sin^4\phi+(\tfrac{5}{16}c^6-\tfrac{1}{4}c^4)\sin^6\phi+\text{etc.}]d\phi$$

$$=4\pi n\left[1+\frac{c^2}{16}+\frac{111c^4}{4016}+\text{etc.}\right]=51.9363+\text{inches.}$$

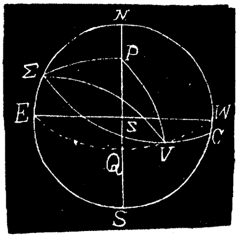
20. Proposed by SAMUEL HART WRIGHT, M. D., M. A., Ph. D., Penn Yan, Yates County, New York.

When will the Dog-Star and the Sun *rise together* in lanitude $\lambda=+42°30'$, if the right Ascension of the said star be $\alpha=6h.\ 40m.\ 30s.$ and the Declination $\delta=-16°\ 33'\ 56''$?

Solution by F. P. MATZ, Sc., Ph. D., Professor of Mathematics and Astronomy in Irving College, Mechanicsburg, Pennsylvania.

According to *Chauvenet's Spherical and Practical Astronomy*, Vol. I., 218, Art. 153, we have for the *hour-angle* of the Dog-Star, $t=\pm\cos^{-1}[-\tan\lambda\tan\delta],=74^\circ\ 10'\ 57.''77,=4h.\ 56m.\ 43.851s.$ The *sidereal* time of the rising of the Dog-star is, therefore, $\Theta=\alpha-t,=1h.\ 43m.\ 46.149s.,$ $=25^\circ\ 56'\ 32''.325.$

The problem now is to find on what day of the year the *Sun* will rise at the sidereal time of the rising of the Dog-Star.



In the accompanying diagram, let Σ represent the Sun just rising; $\angle VPQ=\Theta$; $QZ=\lambda$; $ZP=90-\lambda$; $VP=Z\Sigma=90^\circ$; $\angle PVE=90^\circ$; and $\angle \Sigma VE=23^\circ\,27'\,18''.82$. Now, $\angle PV\Sigma=66^\circ\ 32'\ 41''.18$; and from the spherical triangle PVZ, we deduce $\angle PVZ=25^\circ\,32'\ 24''$, and $VZ=48^\circ\ 30'\ 8''$. Obviously $\angle ZV\Sigma=90^\circ$ $-(\angle PVZ+\angle\Sigma VE)=41^\circ\ 0'\ 17''.18$. From the spherical triangle $VZ\Sigma$, we deduce $\angle V\Sigma Z=$ $29^\circ\ 26'\ 18''$, and $V\Sigma=131^\circ\ 25'\ 23''.4$. Now, $V\Sigma$ is the *longitude* of the Sun at the time the Dog-Star and the Sun rise together. With a mean daily motion of $59'\ 8''.3302$, the Sun reaches this longitude $133\frac{1}{3}$ days immediately succeeding the *twenty-first* of March, or on the *first* day of August.

This problem can be solved in *four* different ways; and some of the results of these solutions indicate the *second* day of August as the required date.

22. **Proposed by F. P. MATZ, D. Sc, Ph. D, Professor of Mathematics and Astronomy in Irving College, Mechanicsburg, Pennsylvania.**

From what kind of dry wood must a ship's log be cut, in order that the log may float with its center of gravity at the water's surface?

I. Solution by B. F. BURLESON, Oneida Castle, New York, and the PROPOSER.

The ship's log, a *circular sextant* in form, floats with the *convex* part immersed. If the central semi-angle be α, the portion of the log *not* immersed is αr^2. Consequently, the portion of the log immersed, becomes,

$$A=(\alpha-4\sin^2\alpha\tan\alpha/9\alpha^2)r^2\ \ldots.(1).$$

If $\frac{1}{G}$=the specific gravity of the log,

$$\frac{1}{G}=\frac{9\alpha^3-4\sin^2\alpha\tan\alpha}{9\alpha^3}=1-\frac{8\sqrt{3}}{\pi^3}=.5531096,$$

which, according to *Hutton's* Table of Specific Gravity of Bodies, is the specific gravity of Dry *Fir*; and, according to *Scribner's* Table of the Specific Gravity of Bodies, is the specific gravity of Dry *White Pine*.

II. Solution by G. B. M. ZERR, A. M., Ph. D, Vice President and Professor of Mathematics and Sciences in the Texarkana College, and Conservatory of Music, Texarkana, Arkansas.

Taking the "log" in the shape of a quadrant of a circle and supposing it to float with the arc down, let G be the center of gravity ρ=density of the